

## TITLE OF THE INVENTION

BODY LIMB MOVEMENT LIMITER

This application takes the benefit of U.S. Provisional Patent Application 60/249,312, filed on 11/17/00.

## 5 BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a body limb movement limiter that uses a non-Newtonian fluid so as to prevent sudden rapid movement of a person's arm or leg, or other joint, thereby preventing injury to the person's injury-recovering joint.

### 2. Background of the Prior Art

In recovering from an injury to the shoulder, knee, or other joint, with or without surgery to the joint, slow and gradual use of the affected area is desired in order to build strength and prevent shortening of the affected tendon or ligament. If the joint is subjected to sudden rapid forces the healing process to the affected area can be compromised resulting in a slowing of the healing of the affected area, reinjury, or further damage to the affected area which can result in the need for additional  
20 medical intervention. This not only results in further discomfort to the patient but slows the overall healing and recovery time.

Devices have been proposed that help limit movement of a person's joint such as the shoulder, knee, elbow, ankle, hip,  
25 etc., so as to prevent the patient from subjecting the joint to

sudden rapid acceleration and consequent forces on the affected area. Such devices help prevent the attendant damage that can result from such rapid acceleration and work with varying degrees of efficiency.

5       The problem with the movement limiting devices found in the art is that such devices, being linear in their deceleration capacity, limit the normal and desired movements of a user of such devices. Such devices fail to discriminate between a desired normal movement associated with the joint and an  
10 undesired rapid movement than can cause damage to the user. These devices tend to make many normal movements, such as walking or carrying groceries relatively uncomfortable. While such  
15 discomforts may be an acceptable tradeoff to some, for the benefit of minimizing damage resulting from undesired rapid acceleration, these discomforts are less than ideal.

Other prior art devices will allow normal movement associated with a shoulder or a knee to a point and once that point is surpassed, a braking action is applied. While these devices will prevent much of the damage associated with full  
20 rapid acceleration of the affected area, the sudden braking action can cause a jerking force on the shoulder or knee, which can result in undue discomfort or some amount of damage to the tendons or ligaments thereat.

Therefore, there exists a need in the art for a device that  
25 will prevent rapid movement associated with a person's shoulder

or knee or other joint. Such a device will allow the user to perform normal desirable functions without undue discomfort, yet will prevent sudden rapid acceleration of a person's limb, resulting in pain, reinjury or damage to the person's joint. The deceleration provided by such a device must be gradual so as not to exert a jerking force onto the user's affected area. Ideally, such a device must be of relatively simple design and construction and must be relatively easy to don and use.

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## SUMMARY OF THE INVENTION

The body limb movement limiter of the present invention addresses the aforementioned needs in the art. The body limb movement limiter is worn by a user and helps prevent the sudden rapid movement of a person's limb in order to protect a recuperating joint associated with the limb. The deceleration provided by the device is gradual and corresponds to the attempted force exertion of the limb which the device is decelerating. The device does not impose a sudden jerking force on the targeted limb. The body limb movement limiter of the present invention is of relatively simple design and construction and is relatively easy to don and use.

The body limb movement limiter of the present invention, as applied to a person suffering a shoulder or knee injury, is comprised of a housing having an opening and a reel rotatably disposed therein. A tether having a first end is attached to the reel and a second end located external of the opening, the tether wound about the reel. A non-Newtonian fluid is disposed within the housing and acts upon the reel during unwinding of the reel. A first strap is attached to the housing and is adapted to be secured about the torso of a person. The non-Newtonian fluid acts as a gradual brake due to the fact that the viscosity of the fluid increases as the force applied to a member within the fluid increases. A first closure means, such as cooperating hook and loop material, is provided for securing the ends of the first

strap together. A second strap is attached to the second end of the tether and is adapted to be secured about an arm of the person. A second closure means, such as cooperating hook and loop material, is provided for securing the ends of the second  
5 strap together. The tether is comprised of a first section removably secured to a second section. The housing is comprised of a first chamber and a second chamber fluidly sealed from the first chamber and such that the reel is disposed within the first chamber and a rotor is disposed within the second chamber such  
10 that the rotor is mechanically connected to the reel such that rotation of the reel causes rotation of the rotor and wherein the non-Newtonian fluid is disposed within the second chamber. Alternately, the body limb movement limiter can be comprised of a first housing and a first arm having a first end disposed within  
15 the first housing and a second end. A second arm having a third end is pivotally attached to the first end of the first arm, and has a fourth end. A non-Newtonian fluid is disposed within the first housing and acts on the first arm during movement of the first arm with respect to the second arm. A second housing has a  
20 third arm having a fifth end disposed within the second housing and a sixth end. A fourth arm having a seventh end is pivotally attached to the fifth end of the third arm, and has an eighth end. A non-Newtonian fluid is also disposed within the second housing and acts on the third arm during movement of the third arm with  
25 respect to the fourth arm. A first stabilizer connects the first

housing with the second housing. The first housing is comprised of a first chamber and a second chamber fluidly sealed from the first chamber and such that the first arm is disposed within the first chamber and a first rotor is disposed within the second  
5 chamber such that the first rotor is mechanically connected to the first arm such that movement of the first arm causes movement of the first rotor and wherein the non-Newtonian fluid is disposed within the second chamber and the second housing is comprised of a third chamber and a fourth chamber fluidly sealed  
10 from the third chamber and such that the third arm is disposed within the third chamber and a second rotor is disposed within the fourth chamber such that the second rotor is mechanically connected to the third arm such that movement of the third arm causes movement of the second rotor and wherein the non-Newtonian  
15 fluid is disposed within the fourth chamber. A first strap connects the first arm with the third arm while a second strap connects the second arm with the fourth arm. A second stabilizer connects the second arm with the fourth arm.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1a is a perspective view of the body limb movement limiter for limiting movement of the upper arm region.

Figure 1b is a perspective view of the body limb movement  
5 limiter for limiting movement of the lower arm region.

Figure 2a is a perspective view of the body limb movement limiter for limiting movement of the upper arm region wherein the body strap and the arm band are both closed.

Figure 2b is a perspective view of the body limb movement  
10 limiter for limiting movement of the lower arm region wherein the body strap and the arm band are both closed.

Figure 3 is an environmental view of the body limb movement limiter showing the embodiments of Figures 1a and 1b secured to a  
15 user.

Figure 4 is an elevation view of the limiter housing.

Figure 5 is an elevation view of the limiter housing having  
20 the cover removed.

Figure 6 is a close-up view of the two tether sections connected together within the limiter housing.

Figure 7 is a sectioned view of the housing.

Figure 8 is a perspective view of the body limb movement limiter for limiting movement of the lower leg region.

Figure 9 is an environmental view of the body limb movement limiter of Figure 8 secured to a user.

Similar reference numerals refer to similar parts throughout the several views of the drawings.

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## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, it is seen that the body limb movement limiter of the present invention, generally denoted by reference numeral 10, is comprised of a limiter housing 12, having a cover 14 for access to the interior thereof, the housing 12 being attached to a strap 16 dimensioned to either fit about the chest of a user, as seen in figures 1a and 2a or the strap 16 is dimensioned to fit about the waist of a user, as seen in figures 1b and 2b.

A first chamber 18 and a second chamber 20 are each located within the housing 12. A take-up reel 22 is rotatably disposed within the housing 12 and passes through the two chambers 18 and 20. A tether 24 has a first end that is connected to the take-up reel 22 and has a second end that is located exterior of the housing 12 and passes through guides 26 located at the opening of the housing 12. As seen, the tether 24 may be comprised of a first section 24a and a second section 24b such that a connector 28 of any appropriate design connects the two sections 24a and 24b. The take-up reel 22 has an automatic take-up mechanism (not illustrated) of any design commonly found in the art such that whenever the tether 24 is unwound from the take-up reel 22, the take-up mechanism causes the take-up reel 22 to automatically rewind the tether 24 onto the take-up reel 22. Disposed within the second chamber 20, a rotor 30 is also connected to the take-up reel 22 and rotates with the rotation of the take-up reel

22. A non-Newtonian fluid 32 is also disposed within the second chamber 20 and substantially fills the second chamber 20. A pair of O-rings 34 prevent the non-Newtonian fluid 32 from escaping from the second chamber 20. Non-Newtonian fluids are those which increase in viscosity with increasing shear forces. A band 36 is connected to the free end of the tether 24. The band 36 is dimensioned to fit about a user's upper arm as seen in figures 1a, 2a, and 3, or the band 36 is dimensioned to fit about the user's lower arm as seen in figures 1b, 2b, and 3. A first closure mechanism 38 secures the two ends of the band together. The first closure mechanism 38 can be of any appropriate design such as the illustrated cooperating hook and loop material.

In use, the strap 16 is fit either about the user's chest or about the user's waist. The strap 16 is secured in place by providing a second closure mechanism 40. The second closure mechanism 40 can be of any appropriate design such as the illustrated cooperating hook and loop material. The band 36 is placed around the appropriate portion of the user's arm - either about the user's upper arm if the strap 16 is placed around the user's chest, or about the user's lower arm if the strap 16 is placed about the user's waist. For use together, a wide strap with over-the shoulder stabilizing straps accommodates both mechanisms.

As the fluid 32 disposed within the second chamber 20 is a non-Newtonian fluid, the more force applied to the rotor 30, the

more viscous the fluid 32 becomes and the more friction the fluid 32 exerts on the rotor 30 thereby tending to dampen the rotation of the rotor 30. Therefore, if the user moves his arm away from his body in a slow fashion, the take-up reel 22 and the connected  
5 rotor 30 will be rotated, via the tether 24 connected to the take-up reel 22, relatively slowly, and the frictional damping placed on the rotor 30 by the fluid 32 will be relatively small. However, if the user moves his arm suddenly and quickly away from his body, the user's pull on the take-up reel 22 and the rotor 30  
10 will be relatively strong. As the rotor 30 is disposed within the fluid 32, the increased force exerted on the rotor 30 results in more frictional dampening by the fluid 32 against the rotor 30. This results in a braking action on the take-up reel 22 preventing the user from the desired quick movement of his arm.  
15 The braking action will be gradual so as to prevent a jerk on the take-up reel 22 and thus on the user's arm. Therefore, a user who is suffering from an arm or shoulder injury or other condition will be prevented from rapid high acceleration movements of the arm, thereby tending to eliminate injury to the  
20 healing tendons and ligaments that can be occasioned from such a sudden movement of the arm. As the braking action is soft and gradual, the arm will not be jerked to a stop and thus injury from such a jerk stop will be avoided.

The take-up of the tether 24 upon the take-up reel 22 will  
25 be controlled by the take-up mechanism. The take-up mechanism is

designed so as not to perform the take-up operation too fast. Additionally, the user tends to make the return movement of his arm back to his body much more consciously, therefore, the gradual braking action provided by the device 10 is not necessary  
5 for the return of the arm.

As the tether 24 is in two sections 24a and 24b, the two sections can be made from separate material. Additionally, whenever the second section 24b becomes worn or otherwise needs to be replaced, the second section 24b can be detached from the  
10 first section 24a and a new section reattached external of the housing 12, thereby eliminating the need to disassemble the device 10 in order to effect a second section 24b replacement.

As seen in figures 8 and 9, the body limb movement limiter 10' of the present invention can also be used to prevent sudden and quick movements of the lower leg of the user. Such a device  
15 10' is comprised of a brace 42 that has a pair of upper arms 44 and a pair of lower arms 46. A pair of plates 48 are provided and are connected together by a first stabilizer 50. Located on each of the plates 48 is a housing 12' such that one of the upper  
20 arms 44 is hingedly connected to a corresponding lower arm 46 within one of the housings 12' and the other upper arm 44, lower arm 46 pair is hingedly connected to each other within the other housing 12'. The lower arm 46 is connected to a rotor (not illustrated), the rotor disposed within a chamber within the  
25 housing, the chamber having a non-Newtonian fluid substantially

filling the chamber. The rotor moves in lockstep with movement of the lower arm 46 to which it is attached. Therefore, the faster the attempted acceleration of the lower arm 46, - corresponding to rapid attempted acceleration of the lower leg of the user - the more viscous the non-Newtonian fluid becomes and the more frictional dampening placed onto the rotor by the fluid, resulting in gradual braking of the lower arm 46 and thus the lower leg of the user. This arrangement prevents rapid acceleration of both forward lower leg movement and rearward leg movement. The brace 42 is placed onto the user such that a second stabilizer 52 that connects the two upper arms 44, rests on the upper surface of the user's thigh. A first strap 54 is wrapped around the thigh and the first strap 54 is connected to itself by an appropriate closure mechanism 56 such as the illustrated hook and loop material. A second strap 58 is wrapped around the lower leg of the user and the second strap 58 is secured to itself by an appropriate closure mechanism 60 such as the illustrated hook and loop material. If desired, some or all components of the brace 42 are padded for increased user comfort.

While the invention has been particularly shown and described with reference to embodiments thereof, it will be appreciated by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.